HEART WEIGHTS OF NORTH AMERICAN CROWS AND RAVENS

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In recent years when so much attention has been focussed on human cardiovascular problems and their amelioration, the study of cardiophysiology in mammals has contributed much toward our understanding of these problems, but basic research in other vertebrates has lagged far behind in this respect. Feral birds, for example, have scarcely been examined since the pioneer investigations on heart rate by Odum (1941). Some revival of interest in this field is indicated by the recent reports of Hartman (1954) and others whose studies have centered on anatomical relationships between avian heart weight and such variables as body weight and altitude. From a perusal of these papers, it is evident that many more data are needed from feral birds before the physiological questions can be answered. Nonetheless, it has been known for many years that the largest birds (in terms of body weight) have the smallest or lightest hearts, relative to body weight, and vice versa. In the Passeriformes, the Common Raven (*Corvus corax*) is evidently the largest living representative, not only in terms of body weight but also in linear measurements. Presumably, ravens and their close relatives, the crows, should have relatively small hearts or heart/body weight ratios.

The present report was undertaken to demonstrate the heart/body ratios of these large passerines. Included in our study are data for 13 ravens, 9 Fish Crows (*Corvus ossifragus*), and 43 Common Crows (*C. brachyrhynchos*).

Methods

The 65 specimens discussed in this paper were taken in late spring or summer, thus representing local breeding populations. Wintering, migrating, or molting individuals have been excluded; our data for birds in these conditions may be used for later considerations. All were collected between 1955 and 1959 at or near sea level. The Fish Crows came from southern Georgia, principally along the coast. Common Crow specimens were taken in the Macon, Georgia, area, and in Washington, west of the Cascade Range from localities ranging from the San Juan Islands south to the Olympia area and the Olympic Peninsula. The ravens were collected at Anchorage, Alaska, except for two individuals from the Olympic Peninsula of Washington. Taxonomically, according to the A. O. U. Check-list (1957:377–379), the Common Crows of Georgia represent the subspecies *paulus*, and the Washington birds belong to a separate species *caurinus*. The ravens from Alaska represent the subspecies *principalis* and those from western Washington, *sinuatus*. Evidence has been amassed by Johnston (in press), however, to show that *C. b. paulus* is synony-

mous with *C. b. brachyrhynchos*, and that *C. caurinus* is simply a well-marked subspecies of *C. brachyrhynchos*.

Weights were obtained in essentially the same method utilized by Norris and Williamson (1955). Birds fresh from the field were weighed on a double-beam balance to the nearest 0.1 gram, and the heart was preserved in 10 per cent formalin. At a later time each heart was thoroughly dried on filter paper, the major vessels were trimmed off close to the organ, and clotted blood was carefully removed before the heart was weighed on a triple-beam balance to the nearest 0.01 gram. Even though Hartman (1954, 1955) weighed only fresh hearts, in our study weights of the formalin-preserved hearts were considered to be as accurate as fresh weights might be, especially since Norris and Williamson (1955:79) demonstrated an insignificant weight difference between the same heart weighed fresh as compared with a later weight taken after formalin-preservation.

Results

Complete data on body and heart weights are given in Table 1 because there are so few extant reliable weights of these birds. Many collectors, preparators, and taxonomists have failed to recognize the two distinctive age groups (first-year and adult) of these and some other corvids, so that many specimens labelled "adult" are in fact first-year birds, and vice versa. It is essential that these differences be recognized so that data obtained from individual specimens might be treated according to the proper age group; otherwise, questionable or erroneous conclusions might be reached. Hartman (1955:231), for example, did not distinguish age groups for the various corvids utilized for his heart ratios, and one would suspect that the data presented there are not precisely accurate. For this reason, plus the fact that he combined data for the two sexes, his data might not be strictly comparable to those given in Table 1. Nonetheless, his figure of 1.20 (heart weight/body weight) for a male of *brachyrhynchos* from Ohio is in general agreement with the average of 1.23 for eight adult males from Georgia. The average of 10 specimens from Florida (0.98) given by Hartman suggests that Common Crows of that region are large birds with relatively small hearts.

Hartman (1955:223 *et sqq.*) did not find any significant sex differences in heart ratios for the many species given in his compilation, but his samples were usually less than 10. Whether or not our data presented for the two sexes can be considered as "significantly different" is a debatable point because these are also small samples. In the largest comparable sample (*brachyrhynchos* from Washington), average weights do indicate some degree of sex difference in the heart ratios (1.12 for males and 1.07 for females), but these differences are not significant at the 5 per cent level. Norris and Williamson,

Table 1

Body and Heart Weights of Crows and Ravens

	Number	Body Weight	Heart Weight	Ht. wt./body wt.
Corvus ossifragus				
adult male	1	310	2.70	1.15
first-year male	2	292.4* (268.5–316.3)	2.43 (2.36–2.50)	1.26 (1.07–1.34)
adult female	5	283.6 (268.6–294.0)	2.59 (2.17–3.00)	1.11 (0.96–1.34)
first-year female	1	300.5	2.24	1.34
C. brachyrhynchos				
Georgia				
adult male	8	447.8 (415.5–509.0)	3.68 (2.77–4.43)	1.23 (1.09–1.52)
adult female	6	403.3 (372.6–444.3)	3.27 (2.95–3.78)	1.24 (1.10–1.34)
first-year female	1	414.0	3.06	1.35
Washington				
adult male	19	415.2 (388.8–486.3)	3.74 (3.00–5.11)	1.12 (0.78–1.33)
adult female	8	367.9 (314.6–421.2)	3.46 (3.04–3.86)	1.07 (0.86–1.19)
first-year female	1	348.9	3.04	0.87
C. corax				
Alaska				
adult male	2	1593.3 (1540.6–1646.0)	14.29 (12.03–16.55)	0.90 (0.73–1.07)
first-year male	2	1355.1 (1305.0–1405.2)	13.91 (13.67–14.14)	1.03 (1.01–1.05)
adult female	1	1233.0	11.77	0.95
first-year female	6	1169.0 (1008.3–1294.0)	12.66 (11.03–15.69)	1.08 (0.98–1.29)
Washington				
adult male	1	1016.7	10.52	1.03
first-year female	1	969.3	11.18	1.15

* Mean weight in grams followed by extremes in parentheses.

however, reported (1955:81) that ". . . both *Cyanocitta stelleri* and certain fringillid species show higher heart ratios in males than in females. (This is likewise true of *Aphelocoma coerulescens*. . . ." Since their samples included 24 *Cyanocitta* and 84 *Aphelocoma*, it is possible that larger samples of *Corvus* might reveal sex differences of a significant nature. For other passerines Williamson and Norris (1958:91) presented additional data indicating some sex differences in heart ratios.

The values of 0.78 (*brachyrhynchos* from Washington) and 0.73 (*corax* from Alaska) represent the smallest heart ratios known for any of the Corvidae. This particular raven was the heaviest (1646.0 grams) of all those examined here, and had the largest linear measurements (wing—441 mm., tail—242, tarsus—68.9, bill from nostril—53.9, depth of bill—28.4). On the other hand, the adult male raven from Washington (heart ratio = 1.03) had the following measurements: weight—1016.7 grams, wing—380 mm., tail—212, tarsus—65.2, bill from nostril—48.6, depth of bill—26.0. The differences in

(Ed. note: Attach the following note to the margin of p. 250 of the September, 1960, **Wilson Bulletin**.)

Correction—Heart Weights of North American Crows and Ravens.—Through an accident in mathematical computations, a few of the values in the original table (*Wilson Bulletin*, 72:250) were incorrect. The first nine lines of the column headed "ht. wt./body wt." should read as follows: 0.87; 0.84 (0.75–0.93); 0.91 (0.75–1.04); 0.75; 0.82 (0.66–0.92); 0.81 (0.75–0.91); 0.74; 0.90 (0.75–1.28); 0.95 (0.84–1.17). In the text and summary it will be necessary to substitute the corrected values above, and the results would indicate that (1) ravens have somewhat larger hearts than the other two species (2) in these three species adult males tend to have slightly smaller hearts than females, and (3) adult crows' hearts tend to be larger than those of the first-year birds, though the opposite relationship is likely in ravens. I would like to absolve the Editor of this journal and my colleague, Mr. Williamson, for these errors.—David W. Johnston, *Department of Biology, Wake Forest College, Winston-Salem, North Carolina, October 26, 1960.*